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US 4618221 A US 4093383 A

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(54) Abstract Title
Multifilar double-star micrometer

(57) A telescope has a transparent reticle mounted in the focal plane. The reticle is marked with a position circle 1, a system of mutually parallel lines 2, and a small circle 3 at the centre of the position circle 2. The reticle can be rotated about the optical axis and its orientation with respect to the celestial sphere derived by ascertaining the point at which a star passing by diurnal motion through the central circle 3 intersects the position circle 2. The polar coordinates of a double star are derived from the orientation of the reticle in two or more positions in each of which the components of the star are precisely bisected by a preselected pair of lines.

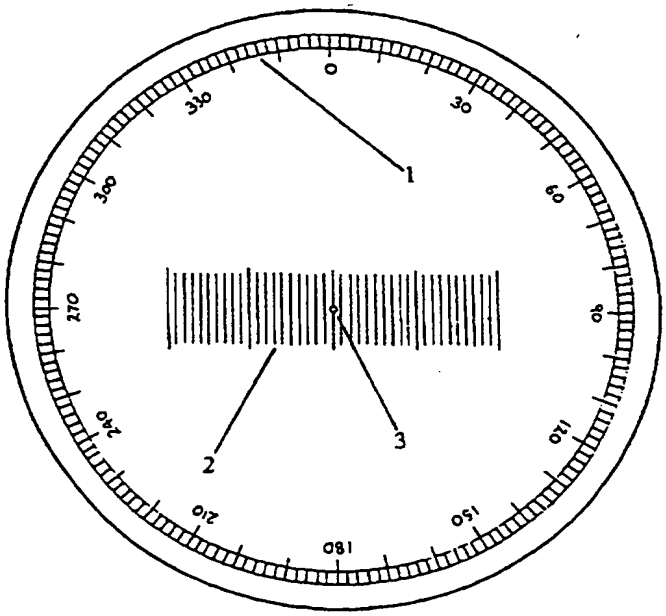

FIGURE 1

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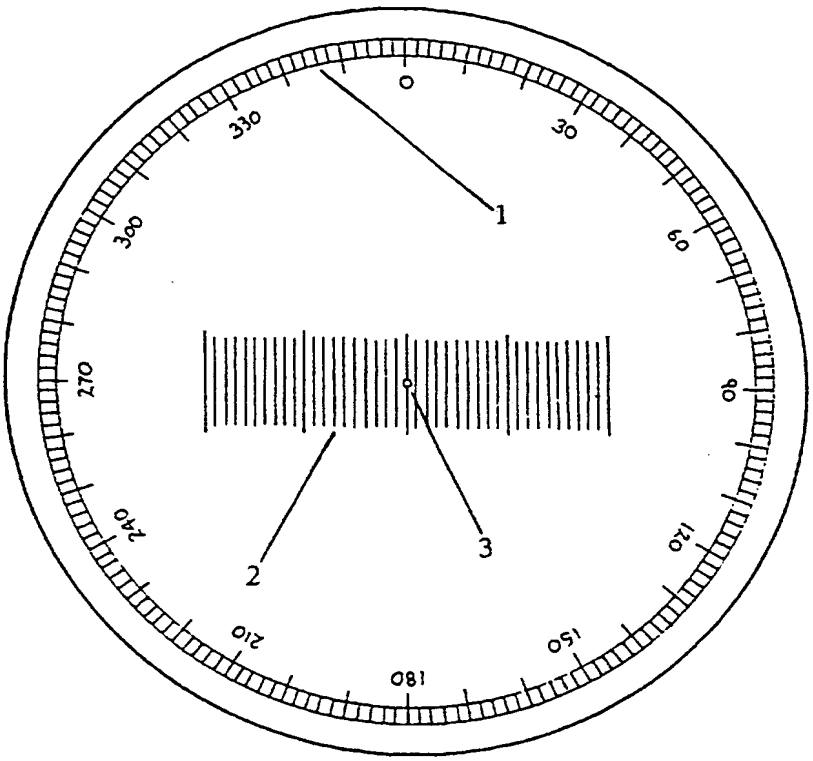

FIGURE 1

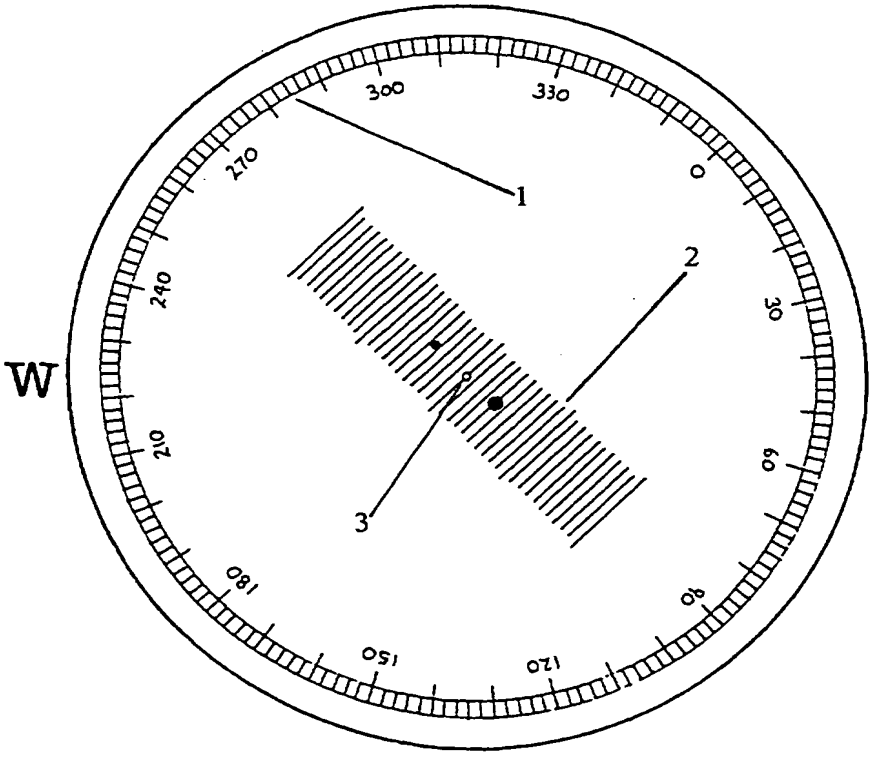

FIGURE 2

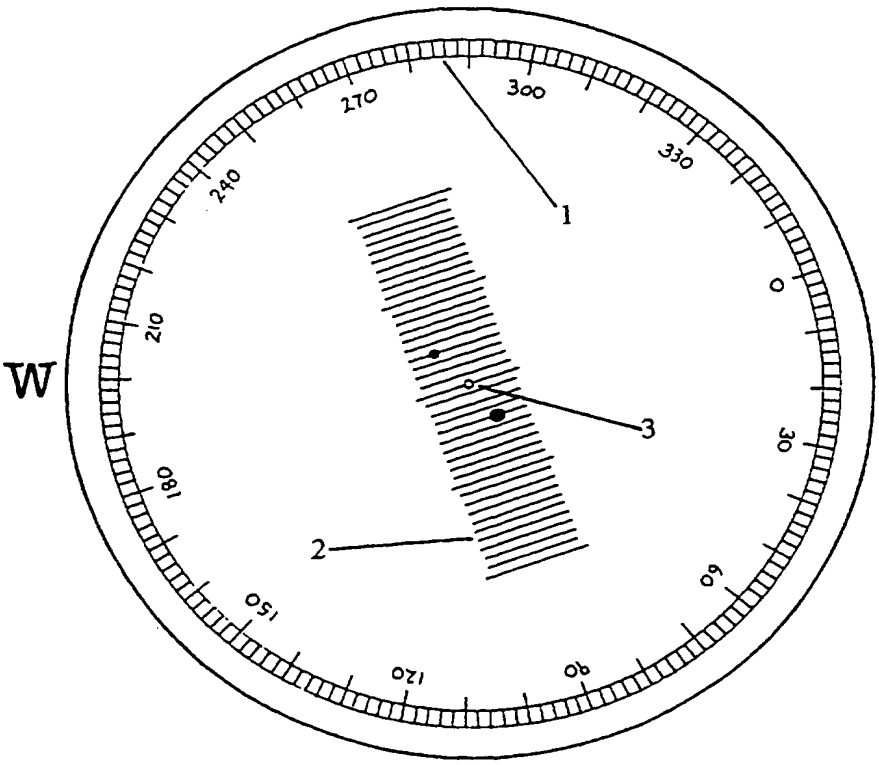

FIGURE 3

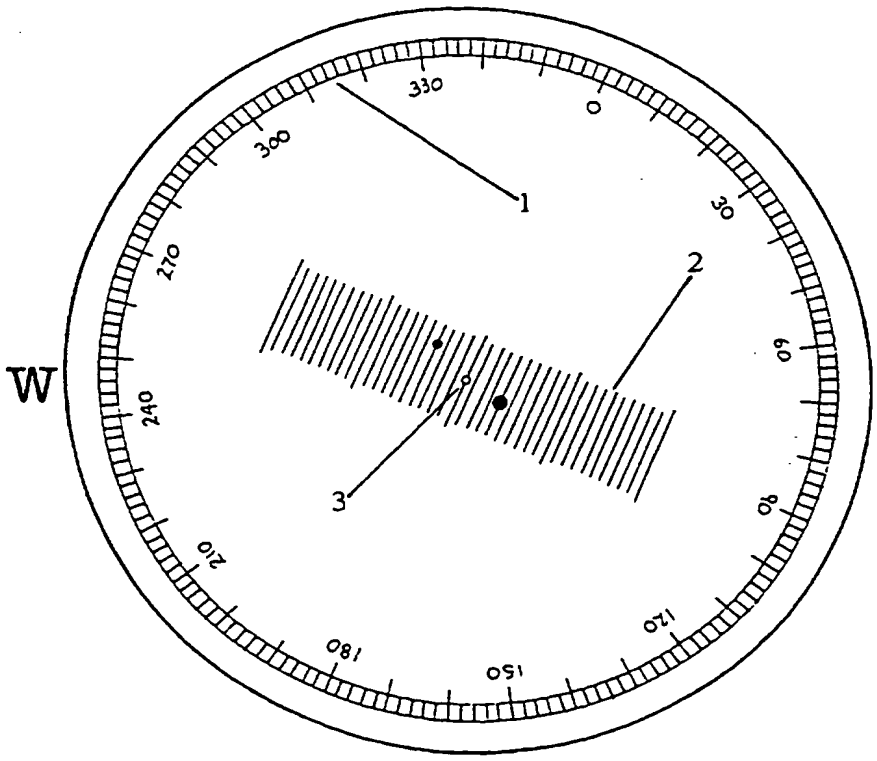

FIGURE 4

MULTIFILAR DOUBLE-STAR MICROMETER

This invention relates to a multifilar double-star micrometer.

Micrometers are used to measure the position angles and angular separations of double stars, from which the orbits of the stars may be computed and their masses derived. The most widely-used form is the filar micrometer, which comprises a crossweb eyepiece with a third web, perpendicular to one of the crosswebs and movable across it. The entire crossweb unit can be rotated and its orientation read at a position circle outside the eyepiece. The position of the movable web is determined by a comparator or a micrometer screw attached to a graduated drum. The position angle is measured by aligning the fixed web with the two components of the star and reading the angle from the external position circle. The separation is measured by orienting the parallel fixed and movable webs until they are perpendicular to the axis of the double star, adjusting the movable web until the components are bisected by the webs and reading the separation from the graduated drum or comparator.

Other forms of micrometer in current use include the diffraction-grating micrometer (less accurate than the filar micrometer) and the double-image micrometer (accurate, but with a limited range of measurement). Diffraction-grating micrometers are not commercially manufactured, since each must be individually adapted to the particular telescope with which it is to be used. By reason of the exacting precision-engineering demands of their construction, double-image and filar micrometers are expensive and difficult to obtain.

According to the present invention there is provided a multifilar double-star micrometer comprising a transparent reticle mounted in the focal plane of a telescope, the reticle being rotatable about the optical axis and marked with a position circle and a system of mutually parallel lines, such that when each component of a double star is bisected by a line, the polar coordinates of the double star are derived from the orientation of the reticle with respect to the celestial sphere as determined by the point at which the image of a star, carried by diurnal motion, diametrically intersects the position circle.

A specific embodiment of the invention will now be described by way of example with reference to the accompanying drawings in which:-

Figure 1 shows the reticle with specimen markings as seen by an observer looking into the telescope;

Figures 2, 3 and 4 illustrate the use of the micrometer by reference to a specimen double star.

The micrometer comprises a transparent reticle mounted in the focal plane of a positive astronomical eyepiece. Referring to Fig. 1, the reticle is laser-etched with a position circle 1 and a system of equidistant mutually parallel lines 2 of known linear separation. A small circle 3 marks the centre of the position circle. Although this micrometer is designed for use with a conventional astronomical system in which the field is inverted and reversed (north at bottom, position angle increasing anticlockwise) the position circle is graduated in the opposite sense so as to avoid unnecessary 180° corrections during the process of reduction. In another design, an alternative set of graduations is provided, increasing anticlockwise, for use with the modified field orientation produced by the incorporation of an extra prism or diagonal into the optical train.

Since the angular separation of the lines (or scale constant) depends upon the focal length of the telescope with which the micrometer is used, the micrometer must be calibrated using any of the standard methods employed with other types of micrometer.

It is assumed that the micrometer is used with a clock-driven equatorial telescope equipped with slow motion controls to both axes. The reticle is illuminated for visibility.

In Figs. 2, 3 and 4, the field orientation is that produced by a conventional inverting telescope, with west (marked **W**) to the left. North is at the bottom. The specimen double star is shown by two black blobs, the larger of which represents the primary.

Referring to Fig. 2, the double star to be measured is brought into the field of view and the micrometer rotated within the drawtube of the telescope until the axis of the stellar components is perpendicular to the lines 2. With one of the components bisected by a line, the number, n, of whole divisions separating the stars is counted. In the case of the specimen pair shown, it will be seen that $n = 8$.

Referring to Fig. 3, the micrometer is then rotated until the components of the star are precisely bisected by a pair of lines separated by n divisions. Without disturbing the orientation of the micrometer, a convenient star (usually, but not necessarily, a component of the double being measured) is brought to the centre of the circle 3, and the telescope drive is stopped, allowing the star to be carried westward by diurnal motion to the position circle. The point at which the star intersects the circle defines position angle 270°, and the reading, θ^1, shown at that point is noted. In the example shown, $\theta^1 = 200°$.

Referring to Fig. 4, the micrometer is next rotated in the opposite sense until the components are again bisected by a pair of lines separated by n divisions, and the above procedure is repeated to obtain the corresponding angle, θ^2. In the example shown, $\theta^2 = 246°$.

These observations, together with the scale constant, contain all the information necessary to calculate the polar coordinates of the double star.

The position angle, θ, is given by:-

$$\theta = \frac{\theta^1 + \theta^2}{2}$$

The angular separation in arcseconds, ρ, is given by:-

$$\rho = \frac{nz}{\cos\alpha}$$

where n is the number of whole divisions separating the components;

z is the scale constant in arcseconds;

and α is given by:-

$$\alpha = \frac{\theta^2 - \theta^1}{2}$$

CLAIMS

1 A multifilar double-star micrometer comprising a transparent reticle mounted in the focal plane of a telescope, the reticle being rotatable about the optical axis and marked with a position circle and a system of mutually parallel lines, such that when each component of a double star is bisected by a line, the polar coordinates of the double star are derived from the orientation of the reticle with respect to the celestial sphere as determined by the point at which the image of a star, carried by diurnal motion, diametrically intersects the position circle.

2 A multifilar double-star micrometer substantially as described herein with reference to Figures 1-4 of the accompanying drawing.

Application No:	GB 9900364.2	**Examiner:**	Conal Clynch
Claims searched:	1-2	**Date of search:**	9 June 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): G2J (J10A1)

Int Cl (Ed.7): G02B

Other: Online: EPODOC, PAJ, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	US 4618221 A	(THOMAS) see Fig 5b & column 5 lines 27-30	1
X	US 4093383 A	(JENOPTIK) see Figs 5 & 6 & column 1 lines 4-9	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

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